# UAS SOLAR FARM ENERGY INSPECTON

**UAS SOLAR FARM ENERGY INSPECTON**


## Abstract

INDRO proposes an offsite Pilot in Command (PIC) operation in a contained operating zone (solar energy farms) with a VO to maintain situational awareness of local traffic. The UAS has pre-programmed flight patterns that are well established and understood by the flight crew



Jose Martin

Jose.martin@mtec.aero

## Initial Approval

| Role | Name | Signature | Date |
|---|---|---|---|
| Prepared | Jose Martin | Jose Martin | October 17th, 2021 |
| Reviewed | Irina Saczuk | Irina Saczuk<br>Irina Saczuk (Oct 21, 2021 17:32 PDT) | Oct 21, 2021 |
| Reviewed | Peter King | PETER KING<br>PETER KING (Oct 22, 2021 08:37 EDT) | Oct 22, 2021 |
| Reviewed | Kate Klassen | Kate Klassen<br>Kate Klassen (Oct 22, 2021 08:35 PDT) | Oct 22, 2021 |
| Approved | Philip Reece | | Oct 22, 2021 |

## Revisions

<table>
<tr><td colspan="5">Revision / Approval Log (Rev bars are to be used to reflect changes throughout the document)</td></tr>
<tr><td><u>Rev</u></td><td><u>Date</u></td><td><u>Revised by</u></td><td><u>Checked by</u></td><td><u>Approved by</u></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><u>Page Affected</u></td><td colspan="4"><u>Remarks</u></td></tr>
</table>

## Table of Contents

# 1 Executive Summary

Indro Robotics designs, manufacture, and operates Unmanned Aircraft Systems (UAS) for the global civilian market. Indro Robotics headquarter is located in Vancouver, British Columbia, Canada. Indro Robotics has successfully operated in several countries and has an excellent safety track record on its operations and UASs that it has designed/manufactured.

Indro Robotics proposed to operate two small UA under 55 pounds called Wayfinder and Endurance for inspections within the confined area of a solar energy farm. These UASs will strictly operate per the requirements and limitations of this concept of operation (CONOPs), based on FAA Order 8040.6 Unmanned Aircraft Systems Safety Risk Management Policy guidance. The IndroWayfinderr and Endurance have a risk classification of 1 per FAA UAS certification guidance. Herein is referred to as RC-1 UAS.

The RC-1 UAS will fly inspections and collecting data in support of solar energy farms. These operations are contained within the energy solar farm location,s which are fenced. The operations are carried out within PART 107 regulatory framework refer to Section 4.4 regulatory analysis of this document.

For the mission types under this CONOP, there are key characteristics:

- Risk Class: RC-1 (kinetic energy-based)
- Mission: Data collection with onboard sensors including LIDAR, infra-red, Electro-Optical.
- Pilot minimum qualifications:
  - ✓ FAA Remote Airman Certificate;
  - ✓ System and platform-specific training, including Aircraft certifications; and
  - ✓ Recurrent Aircraft flight training.
- Aircraft/Operator Ratio: One Aircraft—One PIC.
- Flights occur in contained areas in solar energy farms generally located in less populated areas with a population density of fewer than 500 people per Square mile.
- The operations are not done in population centers.
- Flights in VMC conditions.
- Day operations.
- Beyond Visual Line-of-Sight (BVLOS) operation supported by Visual Observer (onsite) and PIC (Offsite).
- Maximum Operating Altitude: 115 feet above ground level (AGL).
- Flight in icing conditions: Prohibited
- Flight in visible moisture: Prohibited
- Launch and recovery: The launch and recovery occur within the fenced perimeter of the solar energy farm
- Minimum Crew for Operation: 2
  - ✓ 1 PIC (Offsite);
  - ✓ 1 Visual Observer (on-site);

# 2 Reference:

## 2.1 Internal References:

1) Indro SOP OPS-004 Amendment 9 Dated October 8th, 2021
2) Indro Training Document Number: OPS-002 Published 30 April 2016 Updated 17 July 2020, AL-4
3) Flight and Maintenance Manual Endurance Document OPS-019 Dated October 21, AL-4
4) Flight and Maintenance Manual InDro Wayfinder Document number: OPS-26 Dated 20 July 2020
5) Indro ORA-001 Rev NC Dated October 13th, 2021
6) InDro Document Number: OPS-020 SMS program Dated March 2020 AL 5

## 2.2 FAA References

1) FAA AC 107-2A Small Unmanned Aircraft System (Small UAS) Dated February 01, 2021
2) FAA Advisory Circular 120-92B
3) FAA Order 8040.6 - Unmanned Aircraft Systems Safety Risk Management Policy Dated October 04, 2019
4) FAA Order 8040.4B Safety Risk Management Policy Dated 05/02/17
5) FAA Order 8000.369, Safety Management System Dated June 24, 2020
6) FAA Order sUAS JO 7200.23A Air Traffic Organization Policy Dated August 1, 2017
7) 14 CFR Part 107 SMALL UNMANNED AIRCRAFT SYSTEMS
8) 14 CFR Part 91 GENERAL OPERATING AND FLIGHT RULES

# 3 Acronyms

| | |
|---|---|
| AC | Advisory Circular |
| ADS-B | Automatic Dependent Surveillance-Broadcast |
| AGL | Above Ground Level |
| AL | Amendment Level |
| ATC | Air Traffic Control |
| ATO | Air Traffic Organization |
| BVLOS | Beyond Visual Line of Sight |
| CFR | Code of Federal Regulations |
| CONOPS | Concept of Operations |
| C2 | Command and Control |
| FAA | Federal Aviation Administration |
| GCS | Ground Control Station |
| GPS | Global Positioning System |
| ID | Identification |
| IFR | Instrument Flight Rules |
| Kg | Kilogram |
| KV | Kilovolts |
| KWh | KiloWatts Hour |
| LIDAR | Light Detection and Ranging |
| MOA | Military Operations Area |
| MW | MegaWatts |

| | |
|---|---|
| MTOW | Maximum Take-Off Weight |
| NAS | National Airspace System |
| NOTAM | Notice To Airmen |
| PIC | Pilot In Command |
| ORA | Operational Risk Assessment |
| OSHA | Occupational Safety and Health Administration |
| RC | Risk Class |
| RPM | Revolution per Minute |
| RPIC | Remote Pilot In Command |
| SMS | Safety Management System |
| SOP | Standard Operational Procedures |
| sUAS | Small Unmanned Aircraft System |
| UA | Unmanned Aircraft |
| UAS | Unmanned Aircraft System |
| US | United State |
| VMC | Visual Meteorological Conditions |
| VFR | Visual Flight Rules |
| VO | Visual Observer |
| VLOS | Visual Line of Sight |

# 4 Introduction

## 4.1 Operations

The RC-1 UAS operations will be in a contained zone (solar farm Refer to 4.1.1). Operations over population centers or gathering points will be prohibited. No Class A, B, C. D, and or E airspace operations are planned.

sUAS provides a practical solution for the inspection of solar sites at a utility-scale. sUAS supports business efforts to avoid hazardous man-hours, reduce maintenance, inspections, and repairs costs, and maximize energy production. Valuable use cases have been proven across pre-construction, commissioning, and operations & maintenance considering surrounding infrastructure like utility lines, substations, and fencing.

Using sUAS in the solar industry provides more efficient work, safe lives and reduces costs. Without sUAS, inspections are typically completed manually. For utility-scale solar farms, this means either traversing acres and conducting the painstaking process of inspecting thousands of panels by hand or, more commonly, checking only a sampling of panels to identify systemic issues. In some cases, high-cost inspections by small planes may be used. With sUAS, the assessments can be completed a fraction of the time, saving costs while avoiding hazardous man-hours and getting better data.

It reduces high-risk activities by using new technologies to improve safety, increase efficiencies, and enhance company asset management.

The results of a solar inspection by sUAS were compared to manual inspection crews to test the accuracy of measure sUAS data. The results from the manual inspection mirrored the results from the sUAS data with 99 percent accuracy, but the manual inspection took two days compared to two hours with the sUAS. In addition, sUAS can also offer more than solar module inspection data. For example, while sUAS is on-site, there is the opportunity to get accurate information on other site infrastructure.

Managing an sUAS program requires the coordination, oversight, and execution of a wide range of tasks and functions, as shown in **Table 1 - sUAS Solar Inspection Program functions**.

***Table 1 - sUAS Solar Inspection Program functions***

| Function | Description |
|---|---|
| Work Ordering | Placing a work request for drone data. |
| Fleet Management | Scheduling aircraft and sensor payload for each job, managing shipping and storage logistics, following equipment maintenance schedules, and completing repairs or upgrades as needed. |
| Pilot and VO Management | Tracking certifications, licenses, training, and proficiency of each pilot; assigning pilots to each |

| | |
|---|---|
| | job; overseeing travel schedules; ensuring rest requirements are met, and measuring on-the-job performance. |
| Compliance | Checking airspace, flight, and pilot rules and regulations for each job; ensuring that any necessary permits, licenses, Training, exemptions, or waivers are in place. |
| Flight Planning | Determining flight schedule, pattern, altitude, image capture specifications, and any weather-related requirements (e.g., temperature, light, or irradiance limitations) to meet the data goals of the job. |
| **Data Collection** | Flying the drone and appropriate sensor payload, according to the flight plan and safety procedures, to collect the data from the job site. |
| **Flight Logging** | Collecting all flight data such as flight path, altitude, speed, battery usage, and screen captures effectively document and track the flight. |
| **Data Engineering** | Automated or manual processing and analysis of the raw drone data to create a useable data product or report. |
| **Data Management** | Storing, tracking, organizing, and delivering the reams of drone data collected, processed, and analyzed. |
| **Performance Tracking (SMS)** | Continuously ensure company policies are followed, tracking program metrics and measuring program benefits (e.g., costs and hazardous man-hours saved). Analyzing root cost and having a safety-oriented culture. |

### 4.1.1 Solar Energy Farm

Total US solar electricity generation increased from about 5 million kWh in 1984 (nearly all from solar thermal-electric power plants, to about 133 billion kWh in 2020. Utility-scale power plants have at least one megawatt (MW) of electricity generation capacity, and small-scale systems have less than one MW generation capacity. **Figure 1** provides a general location of the solar farms and megawatts across the US.

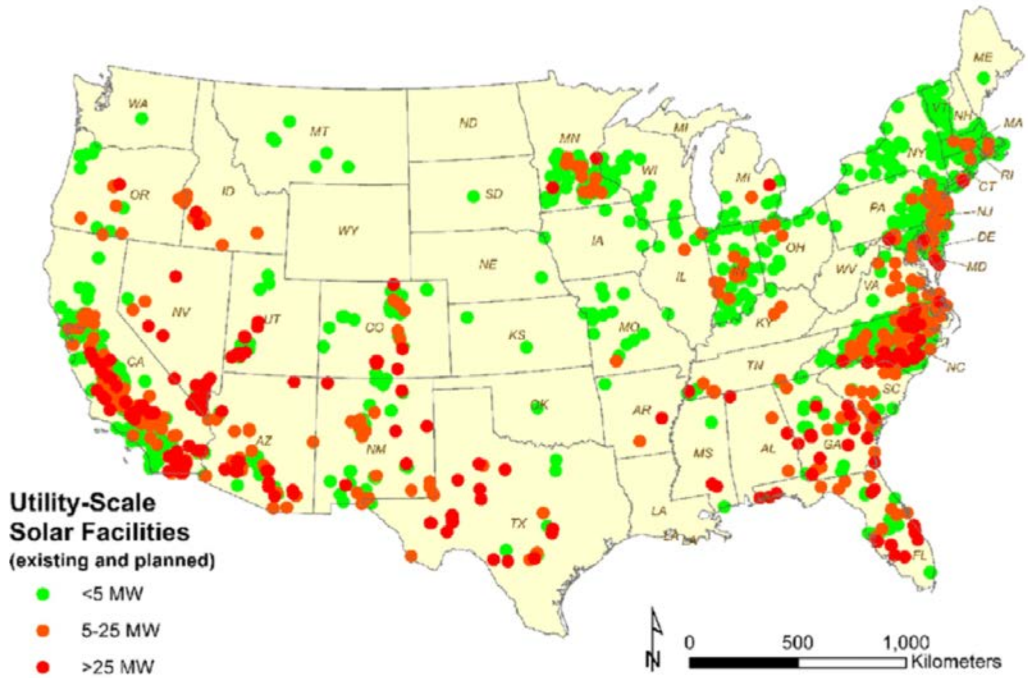


*Figure 1 - SOLAR POWER GENERATION IN US*

The solar energy solar farm general characteristics:

- Primary voltage (12 kV, 23 kV, etc.)
- Range from 1MW to 20MW
- 5 MW is a popular size
- 8 acres to over 100 acres
- Utility overhead facilities
- Solar farm overhead and underground facilities (primary voltage) – Solar farm transformers (pad mount), inverters, panels
- Indro operations are in class G airspace in rural zones


***Figure 2 - North Caroline 5 MGW SOLAR ENERGY FARM***

The solar farms have fencing along the site boundary to keep the site safe from intruders and, more importantly, stray animals that can damage the cells. The perimeter fencing is thus erected to provide site security against vandalism and animals finding their way into the site premises.

***Figure 3 - Fenced perimeter to avoid intruders/animals***

## 4.2 About INDRO

Indro has a long trajectory in designing, manufacturing, and operating Unmanned Aircraft Systems (UAS) for the global commercial market.

InDro Robotics has unmatched UAS expertise to operate utilizing commercial Unmanned Aerial Systems (UASs) to monitor and collect data and provide a wide range of services to industries, including fire and rescue. Indro Robotics customers are as follows:

- Transport Canada
- NASA
- Canadian National Research Council
- NYPA New York Power Authority
- Semios (Large Farms)
- Nokia USA
- Ericsson Texas
- Bell flight
- Shell, to name a few

Indro has accumulated thousands of flight hours and collaborates with leading bodies such as Transport Canada, Canadian Space Agency, and NASA. Additionally, InDro Robotics conducts studies on UASs to develop new equipment and technologies which will expand the uses for UASs. InDro Robotics is one of only four companies in Canada with Beyond Visual Line of Sight (BVLOS) certification.

InDro has held numerous BVLOS certifications over the last five years, including standing permission to fly BVLOS in any Class G airspace Canada wide, at altitudes up to 1500 feet AGL, multiple drones under control at one time, operations in the far North, and operations in a declared emergency zone (fire and flood). InDro also carries BVLOS training for first responders and audits of such groups to ensure up-to-date Training and SOPs.

Indro Robotics has four years' operating under part 107. Some of the operations are with NYPA New York Power Authority, Semios (numerous large farms, nuts, and others).

## 4.3 About Aircraft

The Wayfinder and Endurance aircraft are RC-1 class UAS and integrate many commercial-off-the-shelf (COTS) systems. These aircraft pass comprehensive ground and post-production flight tests before releasing into service.

The UASs have the following MTOW as follows:
- Wayfinder 77 pounds (35 kg) limited to 55 pounds (25 Kg) for this CONOP
- Endurance 6 pounds (10 Kg)

These RC-1 UASs have performed extensive operations counting 200 flying hours and in different operating environments.

Refer to Section 5 for more information on the UASs to be used in these operations.

## 4.4 Regulatory Analysis

Small UAS are subject to the regulatory framework in 14 CFR part 107 when they meet the applicability criteria in § 107.1. Because Indro will use a small UAS for all operations to conduct this operation, the requirements of parts 61 and 91 do not apply to Indro's proposed operations; instead, the operations are subject to part 107.

14 CFR Sec. 107.1 Applicability.

- Except as provided in paragraph (b) of this section, this part applies to the registration, airman certification, and operation of civil small unmanned aircraft systems within the United States. This part also applies to the eligibility of civil small unmanned aircraft systems to operate over human beings in the United States.

14 CFR Sec. 107.3 Definitions.

- Small unmanned aircraft means an unmanned aircraft weighing **less than 55 pounds** on takeoff, including everything on board or otherwise attached to the aircraft.
- A small Unmanned Aircraft System (small UAS) means a small unmanned aircraft and its associated elements (including communication links and the components that control the small unmanned aircraft) required for the safe and efficient operation of the small unmanned aircraft in the national airspace system.
- Unmanned Aircraft (UA) means an aircraft operated without the possibility of direct human intervention from within or on the aircraft.
- Visual Observer (VO) means a person who the remote pilot in command designates to assist the remote pilot in command and the person manipulating the flight controls of the small UAS to see and avoid other air traffic or objects aloft or on the ground.

Indro will use aircraft weighing **less than 55 pounds** on takeoff, including everything on board or otherwise attached to the RC-1 UAS will be limited to operate per the requirements of this CONOP.

The CONOPS looks to have an offsite RPIC assisted by VO. The operations will occur exclusively within the boundaries of a solar energy farm in a well-contained zone. The VO will be trained to assist the RPIC.

Per regulation, RPIC must keep the UAS within sight. Alternatively, if RPIC uses First Person View or similar technology, The RPIC must have a visual observer always keep the aircraft within unaided sight (for example, no binoculars). However, even if the RPIC uses a visual observer, RPIC shall maintain the aircraft close enough to see if something unexpected happens. Neither the RPIC nor a visual observer can be responsible for more than one unmanned aircraft operation at a time.

- Section 107.31 requires that the "remote pilot in command and the person manipulating the flight control of the small unmanned aircraft system must be able to see the unmanned aircraft throughout the entire flight." This rule establishes the need for visual line-of-sight for the RPIC, which allows them to see the UAS's location, attitude, and direction of flight while simultaneously scanning the skies for potential hazards.

- However, Section 107.31 also allows visual line-of-sight to be established by a person (VO) other than the RPIC. Thus, the visual Observer can act as the proxy of the RPIC so that at least one person in the flight crew maintains a visual line-of-sight with the aircraft at all times.
- Section 107.33 goes into further detail about the responsibilities of a visual observer. These responsibilities are merely an extension of the visual line-of-sight duties of the RPIC. In a nutshell, the visual Observer must see the UAS and scan its surroundings for potential collision hazards. The rule also outlines how the visual observer and the RPIC must readily communicate with each other.
- Section 107.37 Operation near aircraft; right-of-way rules established the RPIC responsibility on avoiding other aircraft operating in the area.
- The requirement to conduct safe operations exists in §§ 107.15, 107.19, and 107.23, and the necessity to perform a preflight inspection is codified at § 107.49
  (1) the remote pilot must check that the small UAS is in a condition for safe operation, per § 107.15.
  (2) Section 107.19 outlines the responsibilities of the remote pilot in command under part 107.
  (3) Section 107.23 currently prohibits operating a small UAS in a manner to endanger the life or property of another.
  (4) The preflight check requirements of § 107.49 are distinct from those codified in part 91 and other similar regulations specific to manned aircraft. A remote pilot must conduct a pre-flight inspection per § 107.49. The remote pilot would ensure that the aircraft meets the eligibility requirements to operate for the operation

The CONOPS proposed an equivalent level of safety to fulfill its responsibility defined in 107.15, 107.31, and 107.49 as follows:

1) Limited access to the NAS airspace – Class G Airspace and in rural areas
2) Automation with preset routes and emergency landing procedures
3) Cameras supporting the RPIC visual needs.
4) VO supports the RPIC see-and-avoid responsibilities set out in §§ 107.31 and 107.37.

This CONOPS will outline the limitations, procedures, and technology used to have an offsite pilot while maintaining an equivalent or better level of safety than an RPIC onsite.

The CONOPS, ORA, and safety intend to provide substantiation for a waiver and exemption approval.

The CONOPS is construed as (1) a request for a waiver to operate the small UAS BVLOS beyond sight of the remote pilot in command (RPIC) or visual Observer (VO), and (2) a petition for relief from § 107.15, Condition for safe operation and § 107.49, Preflight familiarization, inspection, and actions for aircraft operation. The CONOPS seeks for limited relief from §§ 107.15 and 107.49 thru an exemption, and relief from § 107.31, Visual line of sight aircraft operation, and § 107.33, Visual observer, according to § 107.200 waivers, to allow the small UAS to operate BVLOS, as described in the Concept of Operations (ConOps).

# 5 Unmanned Aircraft Specifications (RC-1 Class)

Both aircraft have an accumulated 200 hours of operations in the same environment as proposed by this CONOPs.

## 5.1 System Equipment Overview Wayfinder

The following specifications provide an overview of the InDro Wayfinder technical specifications.

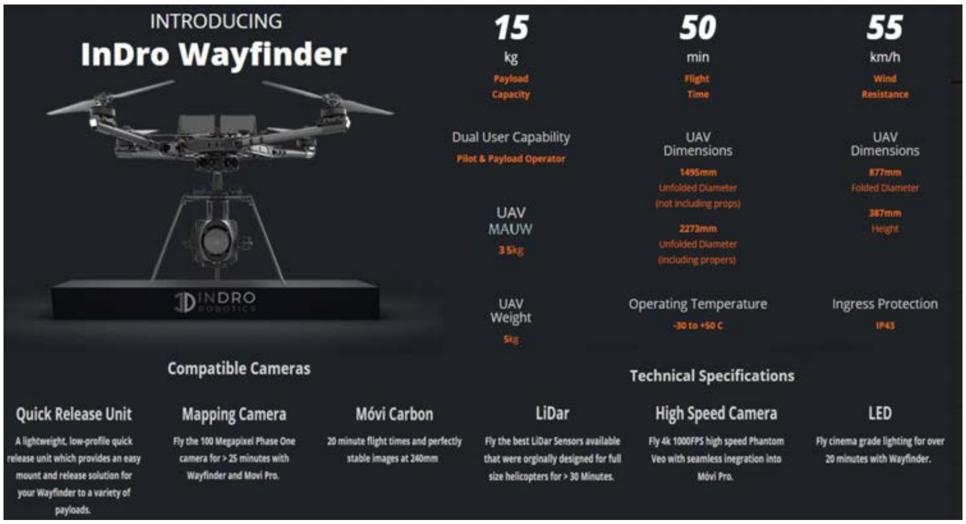


*Figure 4 - IndroRobothics Wayfinder*

## 5.2 Endurance

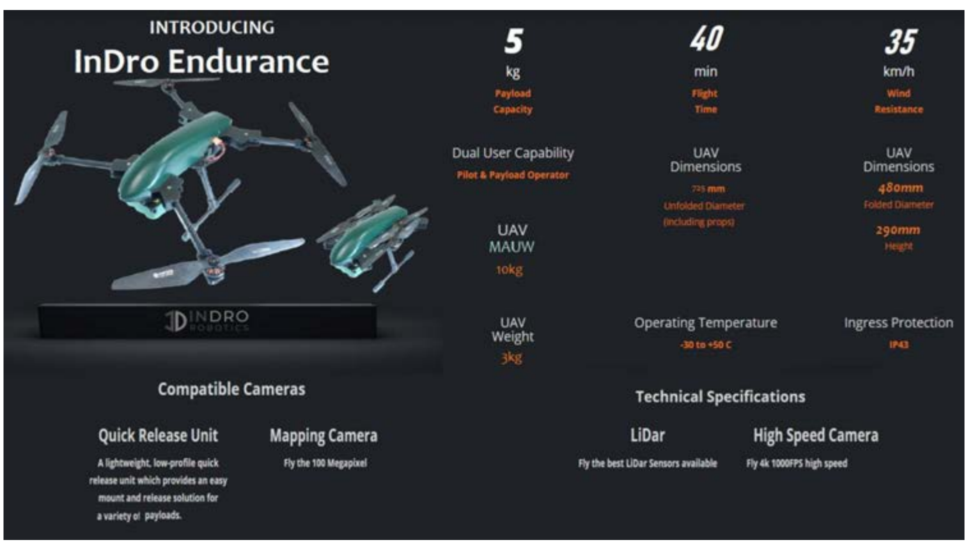


*Figure 5 – Indro Robotics Endurance*

# 6 Indro Standard Operational Manual

Indro Standard Operations Manual is the foundational document of a professional sUAS program. It shapes the operational and safety culture of the organization.

IndroRobotics standard operational manual contains the following items:

a. Operator name, address, and telephone number;
b. Method of distribution and revision;
c. Aircraft description and limitations list by aircraft type and model;
d. Method to ensure the safety of non-participating persons and aircraft;
e. Authority & Control of Flights
f. Regulatory Compliance Guidelines
g. Training Standards
h. Flight & Mission Planning Procedures
i. Equipment Maintenance & Repair
j. Safety briefing of Direct Participants;
k. Direct Participant minimum requirements;
l. Method of communications;
m. Normal operating procedures;
n. Abnormal operating procedures;
o. Emergency procedures;
p. Checklist and workflows;
q. Crew Resource Management;
r. Site Survey;
s. Engagement Plan;
t. Risk management; and
u. Accident Notification. The operations manual must contain procedures for notification and reporting of accidents per 14 CFR § 107.9.

In addition, Indro has established and maintained a Safety Management System (SMS) appropriate for the size, scope, and complexity of operations under this CONOPS per FAA Advisory Circular 120-92B (or current revision).

# 7 Flight Limitations

The operations occur in BVLOS using a VO onsite, an offsite PIC, and the operating area is within the controlled solar farm, usually of about 8 to 20 acres completed fenced.

## 7.1 Meteorological Conditions for Operation

- Indro RPIC will fly with VMC conditions during the day.
- Indro RPIC will not intentionally operate in visible moisture and low temperatures.
- If precipitation is present at the launch site, the VO will communicate with the PIC (offsite), and the RC-1 UAS will not take off.
- Wind: The aircraft will operate to winds conditions of 15 miles per hour. The Pilot keeps an eye on the weather conditions and consults with the VO, who provides the anemometer reading to determine wind speeds. The VO informs the RPIC of any weather conditions changes. Also, the RPIC has weather information on the control station using

weather information via published aviation sources and the onsite camera.

### 7.2 Flight Rules for Operation

- VFR flights are planned during the day (no night).

### 7.3 Flight In Icing Conditions

Indro will not operate under known icing conditions. Furthermore, Aircraft pilots perform preflight briefings, including checking current and expected weather conditions per 14 CFR 107.49 requirements. Refer to SOP 3.2.2 Pre-Flight Crew Briefing Flow for the checklist.

The pilot also performs continuous weather checks during the flight operation, via published aviation sources, through on-screen displays of weather radar and satellite imagery, and finally through VO observation of weather in place.

## 8 Crew and Personnel

### 8.1 Minimum crew and support personnel

The minimum crew is one Pilot-in-Command (PIC) offsite and VO onsite.

### 8.2 Crew Roles, Responsibilities, and Qualifications

The following sections provide responsibilities and qualifications requirements for the RPIC and VO.

#### 8.2.1 The Pilot In Command (PIC) Responsibilities

Aircraft Basic Operator Course, UAS type-specific pilot courses required for the planned mission, and a minimum FAA Remote Pilot Airman Certificate.

A Pilot-in-Command (PIC) refer to 14 CFR § 1.1 the person who has final authority (Go/No Go decision) and responsibility for the operation and safety of flight, has been designated as PIC before or during the flight and holds the appropriate category, class, and type rating, if suitable, for the conduct of the flight. The responsibility and authority of the PIC, as described by 14 CFR §107.19, Remote Pilot-in-Command, apply to the unmanned aircraft.

The Pilot in Command will be located in a sterile mission control element not found in the solar farm. This sterile environment allows the pilot to concentrate their efforts on the mission at hand, avoiding distractions by people, activities, and other operations on the ground

#### 8.2.2 RPIC Training Requirements

The FAA requires any sUAS operator to have a Part 107 certification before flying for any commercial purpose. However, that is only the first step. Indro achieves this with a three-part training program that includes basic introductory training and training specific to the type of equipment the pilot will use and the application.

Indro will comply with 14 CFR §107.63, Issuing a remote pilot certificate with a small UAS rating by hiring/training PIC to pass the PART 107 test requirements shown on 14 CFR Part 107 §107.73 Knowledge and Training.

The training results must be documented, and these logs must have the RPIC and be made available to an appropriate authority upon request.

The PIC has flight reviews per 14 CFR Part 107 §107.65 Aeronautical knowledge recency. In addition, if the pilot conducts takeoff, launch, landing, or recovery, the PIC must maintain recent pilot experience per 14 CFR Part 107 §107.65 as relevant for UAS launch, cruise, and recovery.

Recent Pilot Experience (Currency). The proponent must provide documentation, upon request, showing the pilot/supplemental pilot/PIC maintains an appropriate level of recent pilot experience in either the UAS being operated. At a minimum, they must conduct three takeoffs (launch) and three landings (recovery) in the specific UAS within the previous 90 days (excluding pilots who do not perform launch/recovery during normal/emergency operations). In addition, if a supplemental pilot assumes the role of PIC, they must comply with RPIC rating requirements.

**Introductory Training.** Introductory Training should cover the core principles of your organization's program, such as maintenance guidelines, crew rest requirements, drug and alcohol policy, safety procedures, regulatory compliance, and more.

**sUAS-Specific Training.** Drone pilots should receive hands-on training for the specific drone equipment they will be using. This type of Training sets a baseline for the safe operation of aircraft and ensuring that pilots can adequately take manual control of the aircraft at any time to avoid hazardous situations.

The RPIC Training covers the following topics:

- RC-1 UAS operational procedures
- Traffic avoidance procedures
- RC-1 UAS operational limitations
- Emergency procedures
- Flight training
- Hands-on flight skills demonstration

**Application-Specific Training.** Pilots should be trained to perform one or several specific industry applications. For example, capturing quality data for solar requires specific flight patterns, settings, and conditions, covered later in this section. Pilots should also be trained on proper data handling for their particular use case, such as good organizing and transfer of data files and essential data security techniques.

### 8.2.3 Visual Observer role.

The visual Observer performs the responsibilities defined in 14 CFR Part 107 § 107.33

The responsibility of the VO is as follows:

1. VO should know about the scenarios that can impact flying conditions, including weather conditions, ground hazards, and airborne hazards.
2. VO should be aware of the FAA's Small Unmanned Aircraft (or Part 107) Regulations regarding flights over people and other prohibited activities and support the PIC in flying

within the bounds of what is legally permissible.
3. VO needs to identify issues in the sky and direct the PIC to take the action necessary to avoid those issues.
4. VO should constantly scan the skies and the ground to identify potential hazards and notify the PIC of those hazards as they arise.

It's crucial for the PIC and VO's have robust communication procedures. However, for this to happen, the PIC must trust the VO, and the VO must honor that trust by providing accurate, timely information.

The Observer(s) must communicate any instructions to the pilot to remain clear of conflicting traffic or know essential aircraft functions to understand failure modes that need to be communicated to the RPIC.

The CONOPS proposed that the VO assists the remote PIC see-and-avoid responsibilities set out in §§ 107.31 and 107.37.

The circumstances that may prevent a remote VO from fulfilling those responsibilities will vary, depending on factors such as the operational environment and distance between the VO and the RC-1 UAS. For this reason, an interval exists in which interruption of VLOS is permissible, as it would have the effect of potentially allowing a hazardous interruption of the operation. If the remote VO and the PIC cannot regain VLOS in this time interval, the remote PIC follows pre-determined procedures for the loss of VLOS refer to SOPs 2.3.8 and 3.3.6 - Loss of VLOS. The RPIC uses the RC-1 UAS geo awareness and geo-fencing functions during this time, allowing the RPIC to identify the Location RC-1 UA. If these functions do not perform as intended, The PIC employs a return-to-home sequence by reducing its altitude to the preprogrammed safe altitude for the area per INDRO SOPs 2.3.8 and 3.3.6 - Loss of VLOS.

The primary purpose of a visual observer is to augment the RPIC's sense of situational awareness by providing critical information as defined by FAA AC 107-2A.

The VO must be able to communicate effectively:

- The small UA location, attitude, altitude, and direction of flight;
- The position of other aircraft or hazards in the airspace; and
- The determination that the UA does not endanger the life or property of another.

To ensure that the VO can carry out their duties, the remote PIC must ensure that the VO is positioned in a location where they can see the small UA sufficiently to maintain VLOS. The remote PIC can do this by specifying the location of the VO. The onsite survey done by Indro personnel will define the location of VO and get the RPIC approval. Refer to Site Survey Methodology 3.4.7 Enhanced Program Site Survey.

Indro SOP requires that the RPIC and VO coordinate to:
1) scan the airspace where the sUA is operating for any potential collision hazard and
2) Maintain awareness of the position of the small UA through direct visual observation. This would be accomplished by the VO maintaining visual contact with the sUA and the surrounding airspace.

3) Then, communicating to the RPIC the flight status of the small UA and any hazards that may enter the operation area so that the RPIC can take appropriate action. The RPIC maintains visual thru an onsite camera located

To make this communication possible, Indro SOP 3.5.14 Pilot – Visual Observer Communication Procedures established effective communication between the remote PIC, and VO which does not create a distraction and allows them to understand each other. These communication methods have been proved efficient and safe in Indro BVLOS operations in Canada.

The communication method must be determined before operation. This practical communication requirement would permit communication-assisting devices, such as training Manual 2.3.4, o facilitate communication from a distance.

### 8.2.4 VO Training

The Visual Observers require computer-based Training, testing, and an Aircraft signoff is part of his Training. In addition, the following key points are to be considered for the assistance of the onsite VO when the RPIC is offsite.
The VO goes thru virtual training. The Training contains the following information:

- Why is a VO required?
- Airspace classes
- Weather Conditions – VMC
- General VO Responsibilities
- Scanner VO Responsibilities
- sUAS VO Responsibilities
- How to Scan the Sky
- VO Positioning
- Pre-flight Procedures
- Launching Procedures
- Communicating During a Flight
- Recovering procedures

Note: The observers receive Training on rules and responsibilities described in 14 CFR Part 91 §91.111. §91.113, and §91.115, regarding cloud clearance, flight visibility, and the pilot controller glossary, including standard ATC phraseology and communication, all conditions for operations set out herein, and minimum Training on the RC-1 UAS to understand different failure modes.

An evaluation to check VO understanding and recurrency training is done to maintain VO recurrency

### 8.2.5 Selected crew members are maintenance qualified.

All maintenance will be supervised and completed by the Maintenance Trained Pilot. According to the applicable aircraft published handbook(s), all aircraft and ground support equipment maintenance will be conducted.
See Aircraft Personal Qualification Standards for specific Endorsements required by aircraft

to perform maintenance.
Training Manual 2.3.3 and 2.3.4; minimum requirements for crew provide for regular maintenance and servicing. In addition, InDro has technicians and engineers dedicated explicitly to the task.

### 8.2.6 Communication between the Pilot and VO

The communication between the VO and the pilot is done thru a cellular refer to **Figure 6 - Command and Control Diagram**. The communication is done thru dual cell with a fallback (if one goes out, the other auto kicks in, it has the ability through the cradle point modem). If both cellular services do not operate properly, then an already set up iPad (in the box) starts to give automatic instructions to the VO, such as "the drone will hover for 20 seconds then return home to the take-off point. The iPad will give instructions to the VO; for example, please ensure the take-off point is clear. If necessary, press abort and the drone will descend to the ground at its current location."

The drone would also start a loss link RTL, the loss link procedures if no cellular connection is detected (although in truth, it wouldn't be a loss link as the link to the drone is to the cell shown in **Figure 6 - Command and Control Diagram** not the cell link to the pilot that is just for C2 (command and control.

### 8.2.7 Physical security of the PIC and control station

The philosophy adopted by InDro is very similar to the Sterile Cockpit employed by the aviation industry at large. The sterile cockpit follows procedures per Operations Manual 2.29. During flight operations, the conversation between crewmembers is restricted to mission-oriented patter. As a result, the Ground Supervisor / PIC will make every effort to separate the flight crew from non-operational persons in the vicinity. This will be done using signs briefings, closed doors with lighted signals stating "No interrupt operation underway," the door will be closed. In addition, the Ground Supervisor will be the only contact that the flight crew has with the supported agency; this will be done through team radio.

### 8.2.8 Number of operators and handoff procedures between control stations

Indro will only operate one aircraft per pilot for this RC-1 class CONOP.

### 8.2.9 Plans for the safety of pilot (s) and Observer (s)

Indro complies with all US OSHA, FAA, and local safety-related work rules. Aircraft personnel must use personal protective equipment, such as goggles, hard hats, gloves, etc.
Aircraft personnel is "certified" by Indro Training to perform their duties in the flight zone associated with the operation. Operational Manual 2.3.10.3 and 2.3.11 - Security Plans define crew and site safety activities.

# 9 Ground Station and Support Equipment

## 9.1 Control station configuration

The UA provides continuous control functions necessary for the maintenance of stable flights are allocated to onboard automation. The control station provides the pilot with supervisory oversight. This may include mode selections for automated systems. The information necessary to perform these functions will be offered by the internet network and the downlink between the aircraft and the cellular.

The control station also has

1) Flight Display
2) Supports high-definition video
3) Electronic Checklists
4) Navigation Charts
5) Synthetic Video Augmentation
6) Payload Imagery Display
7) Tactical Situation Display
8) Integrated Comms System
9) External Interfaces
    a. Flight Planning
    b. Mission Planning & Management
    c. Data Dissemination & Analysis
    d. Communications
    e. Network Connectivity
    f. Data Links

The control station has the required redundancy in case of malfunctions of a system rapidly can replace the system that is degraded.

Ground Control Station (GCS) includes a modem and internet for communicating with the RC-1, GCS software and supporting equipment such as a generator in case of loss of power.

The ground control station permits a sterile environment by allowing the PIC to be closed and a signal that states if the RPIC is operating the RC-1 to avoid interruptions during the mission.

## 9.2 Support equipment

This section describes the support equipment used on the ground (launch and recovery systems, ground data terminals, generators, power supplies, ground equipment used to detect and avoid capabilities, etc.)

# 10 Control and Command

This section describes plans involving command and communication functions between different portions of the UAS and stakeholders. This plan includes but is not limited to the communications and data link between other actors, as shown in **Figure 6 - Command and Control Diagram**

The command/control (C2) link for the RC-1 class will operate in unlicensed frequency bands 2.4 and 5.8 GHz. Furthermore, the drone is used over standard 2.4 and 5.8 (unlicensed bands) then connected over cell or wifi back to the internet to command and room.
The C2 link includes a feature to assure C2 link security: The internet connection is encrypted, robust Internet connectivity for video and telemetry, preprogrammed fight capability without the need for a pilot in local proximity to the RC-1 UAS, and GPS positioning

The RC-1 UAS flight management software provides enhanced pilot displays and control capability. In addition, it gives the PIC the ability to check the uplink and downlink capacity in real-time to assure that an appropriate C2 link is functional between the cellular or cellular network and aircraft. This check of the C2 link is a normal part of the preflight procedure before launch. If excessive C2 link dropouts occur, the mission will not happen until the dropout issue stops.

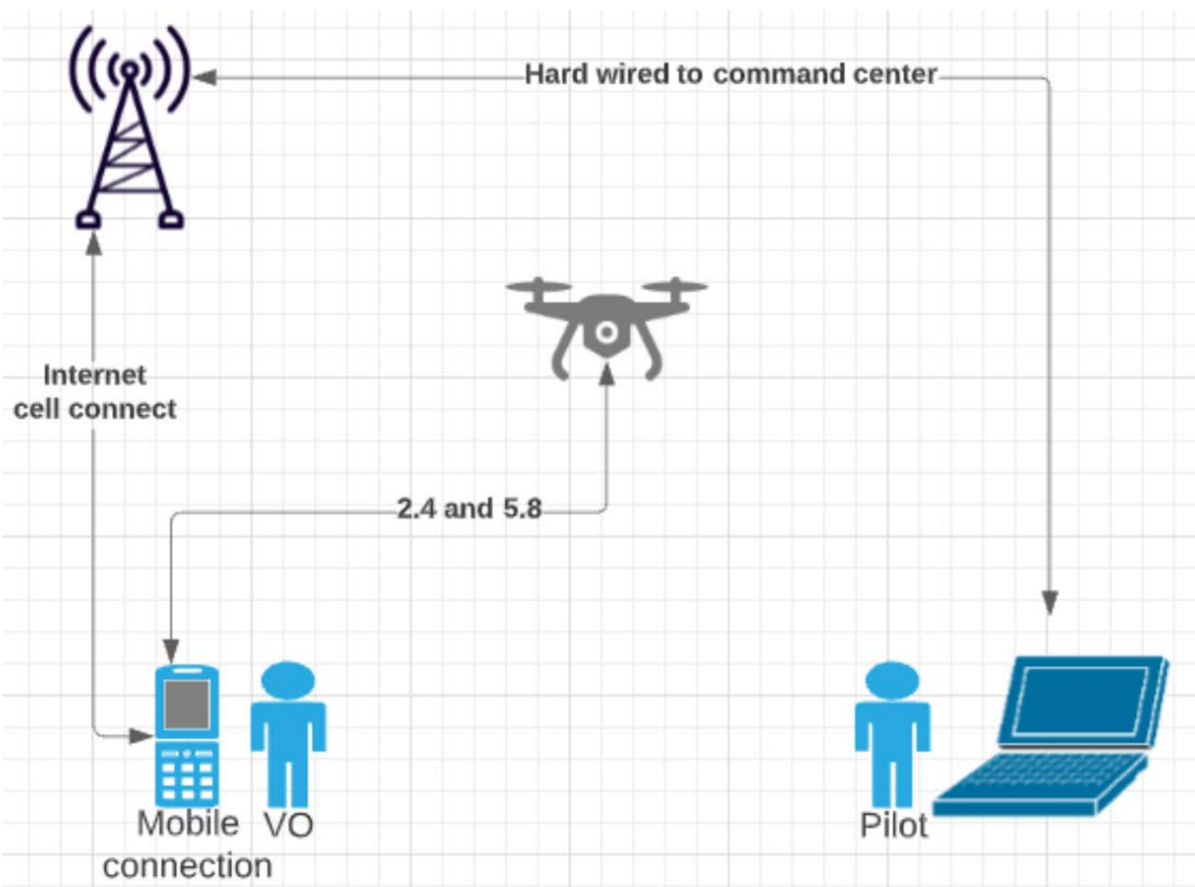


*Figure 6 - Command and Control Diagram*

The use of unlicensed bands posed a risk depending on the zone of operations, as shown in **Figure 7**. The Study of FCC and MITRE shows that this risk is minimum in remote locations. The C2 range requirements are within the VO volume of work defined in 14 CFR § 107.31 Visual line of sight aircraft operation.

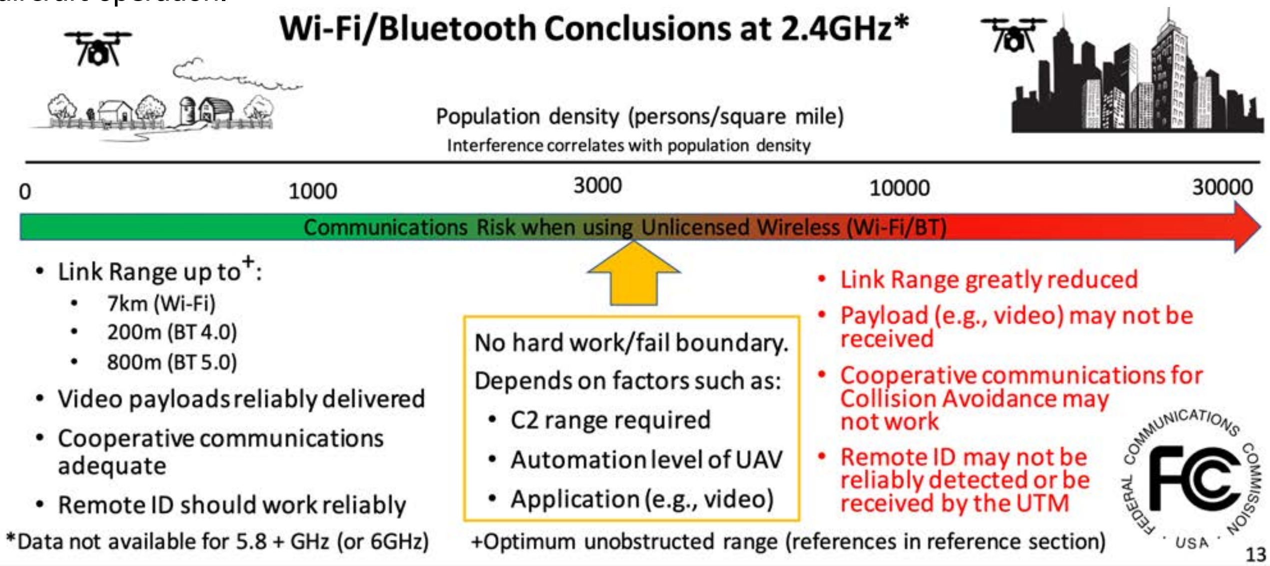


***Figure 7 - Risk of using unlicensed bands***

Per Indro SOP OPS-004 dated July 17, 2020 section 2.28 INTERFERENCE WITH RPAS C&C LINKS, to prevent incidents of interference with the RC-1 Class UAS Command and Control (C&C) electronic links, the PIC or designated crew member will, during the mission site survey and as part of the preflight activities, measure the radiofrequency energy in the vicinity that the UAS will be operating. If the spectrum analyzer indicates a significant risk that the C&C link from the control station will be compromised, the source of the interference will be removed, or the sortie will be moved or canceled.

Prevention of spoofing or hacking of the RPA-controller link is a concern of the flight crew. The crew's protection against these nefarious activities is accomplished by not permitting persons unknown to them to approach the RC-1 Class UAS alone. That person could bind their hand controller to the UAS without the knowledge of the flight crew. It is also to be considered that the perimeter is fenced, and the crew will have complete control of who can enter or not the property during operation.

## 10.1 The Electronic Security of the Control Link

The Command and Control (C2) link between the aircraft and ground control station includes security features, *all* of which would need to be defeated to disrupt the C2 link between the GCS and Aircraft:

- Hop Table. The radio uses a hopping table (often referred to as the "Hop" table) that includes a set of different frequencies and frequency schedules. In other words, the radio doesn't just use one frequency; instead, it uses a variety of frequencies with switching to the various frequencies occurring per a schedule
- Network ID. Each aircraft possesses a specific "network identification" (ID). If that network ID is not correctly inserted into the C2 link, the aircraft will not communicate with the GCS.

## 10.2 Describe the control station configuration

The control station includes a cellular network (both C2 link and video); the computers (a backup is always immediately available); power; internet connection; phones (to contact ATC if needed); etc.

The GCS uses the internet, wherein the GCS can maintain the C2 link despite being farther away from the RC-1 UAS.

### 10.3 Support equipment that is used on the ground by the VO

The VO will be provided with a UAS waterproof case that contains:

1) Modem;
2) Router;
3) Ipad and or camera;
4) cell phone with dual sim;
5) spare props; and
6) back up batteries.

Note: refer to SOP for information.

## 11 Execution of Operations

The section below and section 7.4 of this document show compliance with 14 CFR PART 107 §107.49 Preflight familiarization, inspection, and actions for aircraft operation. In addition, the steps are shown on Indro SOP OPS-004 dated July 17, 2020, provide detailed information on how to execute the operations before operating:

Before the flight, the remote pilot in command must:

### 11.1 General – Site Set-Up Flow SOP Sec. 3.2.3

The following sections show compliance with 14 CFR 107.15 and Sec 107.49 requirements. In addition, the use of a camera provides a means by which the RPIC can conduct the responsibilities set out in these two sections.

The RPIC request the VO to set the IPAD camera. Then, the VO will pan it around to identify an area of concern; meanwhile, the VO communicates with the RPIC. (note: Once the RC-1 is in flight, the RPIC can use the UA camera to identify areas of concern if needed).
The RPIC assesses the operating environment and aircraft airworthy through communication with the VO using Indro SOP checklist and if needed thru video camera feed, considering risks to persons and property in the immediate vicinity on the surface and in the air; refer to **Figure 8 - RPAS Setup flow Responability breakdown** and **Figure 9 – Site Set-up Breakdown of RPIC and VO Responsibilities**.

This assessment must include:

(1) Local weather conditions;
(2) Local airspace and any flight restrictions;
(3) The location of persons and property on the surface; and
(4) Other ground hazards. All flights paths will be in the pre-determined flight detailed herein. In addition, all flight paths will be visually inspected to ensure that the area is clear of personnel and that employees have identified any obstacles before and during the flight
Note:

a) The RPIC will set the limits depending on the mission, then review the weather online at the time of flight, and then request the VO to hold up the anemometer and report on the conditions they Observer.

b) The RPIC will be responsible for checking the METAR and TAF for the date and time of the proposed operations. The operations will only proceed without precipitation, visibility of 3 statute miles can be maintained, and the maximum wind speed (including gusts) does not exceed 15 miles per hour. The operations can be suspended at any point upon changes in the weather conditions beyond the prescribed limitations. The VO will provide onsite information to the PIC. The PIC and VO will discuss the weather conditions during the safety briefing and the operations.

- Ensure that all persons directly participating in the small unmanned aircraft operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards;
- Require to complete a safety analysis required by Health Administration in equipment operation by crew members (RPIC and VO);
- The remote PIC must ensure sufficient VO(s) are used to observe the airspace two statute miles surrounding the RC-1 UAS in flight and to detect and track all air traffic or hazards;
- Checks are done before starting the mission. In addition, a preflight checklist will be completed by the flight crew before all flights. The preflight checklist will include the inspection of all equipment used for the flight and require testing of all functions of the RC-1 UAS; refer to **Figure 8 - RPAS Setup flow Responability breakdown**.

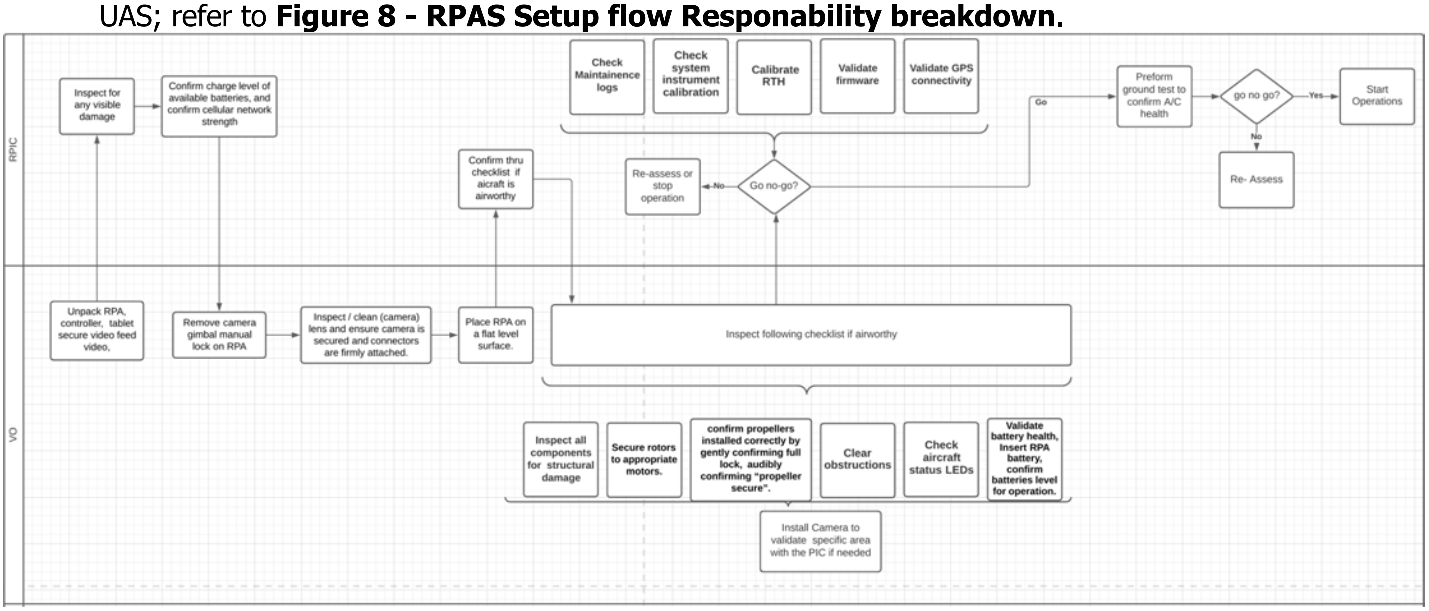


*Figure 8 - RPAS Setup flow Responability breakdown*

- Please refer to SOPs 3.2 entire section contains the checklists used throughout the mission; 3.2.7 refers specifically to pre-take-off. The RC-1 UAS will not fly if an anomaly is found during the preflight checking.
  - Ensure that all control links between the ground control station and the small unmanned aircraft are working correctly. All emitters and control links to be used for the operations must comply with existing FCC regulations and all provisions of the FCC authorization granted for the emitter;
    - Note: before the flight, check for possible interferences using a spectrum analyzer, then the RPIC would walk the VO through it in the

same way they would the wind reading.

- Ensure that any object attached or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft;
- If the small RC-1 UAS is powered, ensure that there is enough available power for the small unmanned aircraft system to operate for the intended operational time;

- Complete a risk assessment for each flight outlining the risk of the flight and a detailed plan to mitigate the risk by crew RPIC and VO. Immediately before the planned operations, all crew members will undergo a safety briefing to be held by the crew members (RPIC and VO). At a minimum, the following items must be addressed in the safety briefing:
  - Meteorological conditions
  - Designated positions, physical locations, responsibilities, and Crew Resource Management,
    - The RPIC sets launch and recovery in advance from reviewing the site images, then confirmed by the camera on arrival.
  - Planned flight operating area,
  - Designated launch and recovery areas,
  - Verification of geofence boundaries,
  - Verification of return home and land flight profile, and course,
  - Verification of emergency landing site(s), land profile, and course,
  - Procedures for the avoidance of other aircraft,
  - Procedures defined by the regulator for operating under their approval;

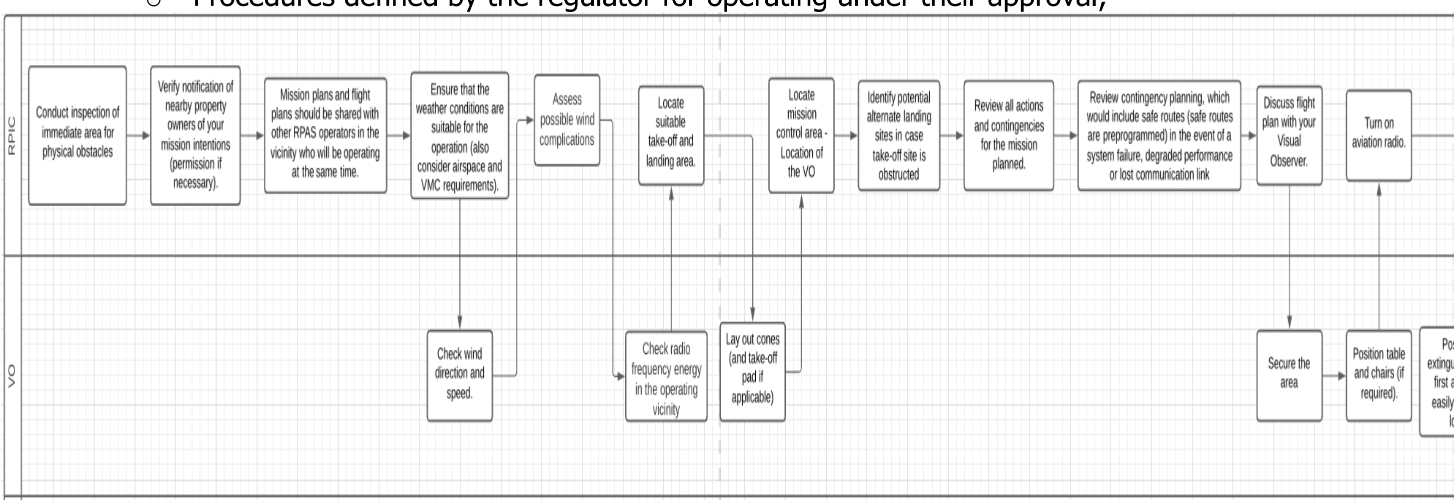


*Figure 9 – Site Set-up Breakdown of RPIC and VO Responsibilities*

During operations, the activities are as follows:

- All flights conducted shall include a pilot in command and VO.
- Individuals directly participating in the operation of the RC-1 UAS must be easily identifiable visually (e.g., apparel, safety vests);
- The VO will monitor the airspace for any approaching aircraft and notify the remote pilot in command to suspend operations. The flight will be suspended until the airspace has been

cleared by other aircraft.
- VO will advise the RPIC on any changes in weather conditions
- The pilot will ensure that the RC-1 UAS operates at an altitude exceeding 115 feet above ground level during daylight hours.
- The RC-1 UAS position lights will be operational and required to make them visible and conspicuous. Under clear conditions, the RC-1 UAS to be used usually is visible within the 3-statute mile range. Still, the conspicuity of the RC-1 UAS will be enhanced by the application of high visibility markings and a strobe light. These will be deployed even during the daytime. Operations will be suspended if weather conditions reduce visibility to less than three statute miles.
- All flights will be conducted with equipment and software that allows the pilot to continuously monitor the attitude, altitude, speed, direction, and location. In addition, the RC-1 UAS possesses geo-awareness and geo-fencing, allowing the RPIC to augment situational awareness.
- RC-1 UAS will be equipped with a return home function in the event of a malfunction.

Note:
1) The need for a VO is in recognition of the reduced field of view available to the RPIC when relying on the RC-1 UAS onboard camera. In addition, the ground station of the RC-1 UAS will have a visual display that will relay real-time information to the RPIC regarding the RC-1 UAS position, altitude, and direction of flight. This information must be available to the RPIC at all times. Otherwise, the operations will be suspended.
2) A geofence set up using a software platform to prevent the UAS from flying outside the proposed operational zone. The geofence is established along the borders of the fenced Solar farm and defined by the four coordinates indicated during the onsite survey done by Indro. A test will be done to establish the geofence's effectiveness. The companion mobile app will be set to display a visual prompt and play an audible signal should the RC-1 UAS fly outside the geofences, and the RC-1 UAS will be set to hover in place automatically.
3) The RC-1 UAS for the operations must have gone through regular maintenance procedures as prescribed by Indro. All scheduled maintenance activities must be documented, including repairs, replacement of components, modification, an overhaul of the drone, and any software upgrades. At a minimum, the logs should include details on what type of work was performed, who conducted the maintenance, and when maintenance was done. Such records must be kept by the RPIC and must be available for review by authorized representatives.

## 11.2 Geographic location and airspace

The CONOP missions are energy solar panel inspection in solar energy farms, using various tools, such as electro-optical, infrared, SAR, LIDAR, multi-spectral, etc. The critical parameter for the payload is that the payload must not affect the safe performance of the RC-1 UAS for all phases of flight: Preflight Checklist, Take-off, Loiter, Cruise, and landing. Therefore, no payloads are ever flown without comprehensive testing at Indro to assure that the payload does not affect safe aircraft performance or degrade the C2 link.

The inspections are done following a preprogrammed flight pattern. In addition, RC-1 UAS will complete a grid pattern flight taking photos at Geo-referenced locations to allow for post-processing and inspection. The solar farms are located in airspace class G airspace.

The RC-1 UAS will apply appropriate mitigations to minimize airspace conflicts. The limitations are as follows the aircraft will operate only within the Solar Energy Farms boundaries. Additionally, the aircraft will be operated from 50 foot to 115-foot AGL.

### 11.2.1 Proposed Operating Airspace Particulars

The operating airspace particulars are as follows:

- ✓ Private land (contained area protected by a fence)
- ✓ Low Population, less than 500 people per square mile, in the ground below;
- ✓ Significant open space for emergency landings;
- ✓ infrastructure identification that RC-1 UAS will purposely avoid, minimal ground traffic and other Aircraft traffic densities, etc.;
- ✓ Low air traffic density;
- ✓ No highway or road crossings will occur to limit exposure to risk; and
- ✓ Population centers will always be avoided so no overflight of people.
    - Population centers are locations where people are likely to collect: schools, hospitals; town centers; shopping centers/malls; parks; business parks, etc.

### 11.2.2 Congestion of the Operating Areas

The operations will mainly happen in remote locations in class G airspace since most of the Energy Solar Farms are located in this area.

The RC-1 UAS for this CONOP will operate in contained private land in low population areas with a population. In addition, Indro will use local radar histories and tracks to understand the potential airspace congestion. Finally, Indro uses local airport daily operations counts to characterize the airspace yearly.

Indro will show compliance with 14 CFR §§107.41, 107.43, and 107.45 thru a comprehensive communication plan and site survey. Before operations on these locations, it will start communication with ATC to receive authorization for the operation. This communication is part of a comprehensive communication plan. This communication with local air traffic control (ATC) provides potential air-to-air threats in the planned flight space.

The communication plan will provide information on how Indro may interact with ATC, for example, radio, telephone, or email contact with the local ATC, per the local ATC requirements. In addition, RC-1 UAS will work with local ATC and others to understand the congestion and develop de-conflict mitigation schemes to maximize operational safety for areas where congestion may be present. "Heat maps" showing airspace usage by day of week and time are valuable tools to characterize the airspace and expected traffic. In addition, local airport operations (per day, week, month, or year) help assess the local air traffic environment.

Thus, Indro will follow this comprehensive process to understand the airspace users and implement the communication plan and operational risk mitigation plan to de-conflict with the airspace users with the information obtained thru the process.

Finally, during the operations, the VO will provide oncoming traffic with defined procedures for the pilot to avoid the threat.

## 11.3 Launch/Fly/Recover aspects of the operations

### 11.3.1 The Mission

The CONOP missions are energy solar panel inspection, using various tools, such as electro-optical, infrared, SAR, LIDAR, multi-spectral, etc. The critical parameter for the payload is that the payload must not affect the safe performance of the aircraft for all phases of flight: Preflight Checklist, Take-off, Loiter, Cruise, and landing. Therefore, no payloads are ever flown without comprehensive testing to ensure that the payload does not affect safe aircraft performance or degrade the C2 link.

#### 11.3.1.1 Operations

Indro will operate RC-1 class systems *with an offsite pilot*. The pilot will be located in a control station within the USA.
To assure an appropriate level of safety, all RC-1 class systems for this CONOP will be operated with a Visual observer (VO) onsite. The VO will provide the pilot-in-command (PIC) with situational awareness of the oncoming traffic with an equivalent level of safety that meets the intent of 14 CFR Sec. 107.31 and Sec. 107.33.

Furthermore, visual Observer (s) scan for air traffic conflicts and alert the PIC during takeoff and landing operations. PIC and VO use cellular or internet communications to provide the PIC with immediate information regarding local air traffic.

In addition, Indro utilizes a comprehensive site survey process to identify likely users of the airspace and contact processes for the specified users. Then, aircraft maintains contact with those airspace users, including current and airspace management tools, such as NOTAM or the FAA flight briefing tools https://www.1800wxbrief.com/afss/#!/ and drotams per https://skyvector.com.

### 11.3.2 Launch and Recovery Details/ Location(s)

The launch and recovery occur in the same solar energy farm in areas that provide appropriate space and avoid obstacles affecting the launch and recovery location. The launch and recovery location is clear of objects by 10m, clear road by 30m, and rapidly ascends to the operation level 115 foot AGL. The PIC will identify rally points during the survey defined in SOP section 3.4.7 Enhanced Program Site Survey.

#### 11.3.2.1 Aircraft's proximity to people, infrastructure and surface Aircrafts

Operations occur with only trained personnel within the contained zone who are knowledgeable and prepared for these operations.

During the survey, people, obstacles, phone/electrical apparatus (including substations) or other infrastructure, and RC-1 UAS locations are identified. The Operational Risk Assessment aligned with this CONOPs will guide Indro in developing specific distances, where needed, from obstacles, infrastructure (including critical infrastructures, such as substations, oil/gas pumping stations, etc.), or other items wherein a specified distance from the item will provide an appropriate level of safety.

Flight planning will always include knowledge of structures, infrastructure, and other local features to be avoided.

#### 11.3.2.2 Aircraft's proximity to other NAS users

The Indro SOP section 3.5 NORMAL AND ABNORMAL BEYOND VISUAL LINE OF SIGHT PROCEDURES prepared by Indro shows compliance with 14 CFR §107.37 Operation near aircraft; right-of-way rules.

If another UAS will fly near or within the flight area planned for this CONOP, coordination occurs.

Indro's PIC and VO will always focus on maintaining a safe separation distance from all other airspace users, including following air traffic commands to maintain safe separation. In addition, Aircraft will fly at a low altitude with a maximum of 114' AGL. In case of another airspace user in the area, the PIC will command the aircraft to reduce altitude to a safer position or land.

For other aircraft in the airspace where RC-1 UAS will fly, Indro will use various methods to characterize air traffic usage. For instance, many air traffic regions collect airspace use data converted to "heat maps" per day of week and time of day to display air traffic density and altitudes. Another tool is the Indro Outreach process that Indro uses to gage air traffic density: several airports in the region; the Number of airport operations per day, week, month, or year; identification of agricultural users; identification of military operations; engagement with local air traffic and flight service stations; identification of glider, ultralight, or other less conventional general aviation aircraft; engagement with local airport managers; engagement with local flight organizations or clubs; etc.

#### 11.3.2.3 Crew Communication

The Observer and pilot are intimately linked for launch and recovery. In addition, radio links and backup links are provided to all operations personnel.
Before starting the operation, the RPIC validates the cellular networks and conducts the VO to validate the cellular connection at the corner of the solar farm.
The communication consists of a dual cellular link. Indro SOP section 3.5.14 provides further information on this area

#### 11.3.2.4 Operations-Over-People

The proposed CONOPS shows compliance with 14 CFR §107.39 Operation over human beings.

Aircraft will not fly over any persons associated or not with the operations since the operations occur in private areas, which are fenced, and via flight paths that are intentionally directed to avoid people on the ground.

Only knowledgeable personnel are allowed into the fenced energy solar farm now of the operation. The ground crew is debriefed on the operations and at which time the operations occur. All Indro's personnel are trained to perform specific operational duties, including working in this fenced zone

#### 11.3.3 Minimum and Maximum Operating Altitude

Indro will operate the RC-1 UAS for this CONOP from the surface to 114 feet above ground level (AGL) or above surface level, such as a water surface. The minimum operating altitude will be 50 feet.

#### 11.3.4 Request for Exclusive Airspace (Blocked Airspace)

Indro will not be requesting exclusive or blocked-off airspace.

#### 11.3.5 Day and Night Operations

Day flights only. No flights to take place 1-hour sunrise and 1 hour before sunset.

#### 11.3.6 Maximum Cruise Speed

Both aircraft are limited to operate at 20 mph

#### 11.3.7 PIC/Aircraft Ratio

1:1 to ratio. It is considered in this CONOPS

#### 11.3.8 The Automation Level

RC-1 UAS uses an autopilot preprogrammed with the mission plan, and the pilot is always in the loop. Thus, allowing the pilot to make flight path changes, waypoint changes, altitude changes, etc., as needed. Furthermore, with the VO communication, the pilot uses the situational awareness provided by the VO, camera, and onboard UA sensors to understand appropriate flight path changes that may need to occur to avoid oncoming flight traffic or ground obstacles.

All *actions* by the aircraft are preprogrammed into the aircraft by the pilot to account for various flight environments. Finally, the pilot remains the ultimate authority and control for the aircraft. Should the C2 link be lost, the aircraft actions are known due to the deterministic processes of the aircraft's autopilot and the flight management system.

### 11.4 Coordination And Communications Required To Conduct The Operations

#### 11.4.1 Community Outreach Plans

Indro possesses a comprehensive process for community outreach. For all contacts engaged through the community outreach process, Indro obtained their preferred engagement process (FAX, phone, email, text, etc.) to provide continued engagement before, during, and after any operations. This outreach process includes:

- Connecting with local pilot organizations.
- For example, Regional Pilots Association, flight schools as well as ultralight organizations.
- It connects with local military flight-related organizations: all military organizations that may use the airspace via scheduled training routes, MOAs, or other particular use airspaces.
- Connecting with relevant ATO/ATC. Indro meets with local ATO/ATC personnel as well as local Flight Service Station personnel. In Washington, DC, FAA personnel could also provide contacts, regional and local, for Indro to engage.
- Connecting with Airport Managers. Indro will identify ALL airports, public and private, and communicate with the manager. Multiple online airport information sources, such as "AirNav.com," provided private and public airports contact information.
- Connecting with other aviation users: Gliders; ultralights; etc.
- The site survey process provides multiple opportunities for Indro to discover, identify, engage, and maintain contact with airspace users in a planned flight area.
- Connecting with agricultural aviation users.
- Connecting with other government aviation users, including federal, tribal, local, etc.

### 11.4.2 Flight Plans and Air Traffic Control (VFR)

The onsite survey includes engagements with ATC to ensure that all parties relevant to a flight operation are aware and on the same page about planned operations. As done previously, Indro has worked with the local/regional ATC offices to provide the engagements, including flight planning, desired by the local/regional ATC. In addition, Indro works with the local ATC to understand the local ATC preferred communication/engagement process.

Indro will not launch into IFR conditions. Furthermore, Indro RPIC continuously monitors the weather to ensure a VFR/VMC flight.

### 11.4.3 Liaisons with Air Traffic Control

The Pilot-in-Command is responsible for liaison with the local/regional. Indro site survey process, the interaction processes, and all aircraft crew members know the local/regional ATC expectations.

The engagement checklist that cites all contacts for a flight area includes the expectations of the local/regional ATC: when to contact, what information is needed, etc.

Multiple modes for ATC engagement are determined: whether by radio, phone, internet, or other. Furthermore, a primary engagement mode is developed with ATC, such as phone contact, with a preplanned backup, such as radio.

### 11.4.4 Emergency Procedures

Emergency procedures are provided for various events related to aircraft operations: lost C2 link; engine out; lost GPS; etc. The procedures are included in the operational manuals for the specific Aircraft unmanned aircraft systems and linked to the flight management systems to provide pop-ups or supplementary "windows" to the pilot when particular events occur.

Indro SOP provides additional emergency procedure details.

### 11.4.5 MISHAP Reporting Procedures

INDRO possesses a Safety process with well-defined MISHAP reporting processes per Operations Manual 2.8 and SOP 2.3.15. INDRO will comply with Part 107 Accident Reporting Form and show compliance with §107.9 Accident reporting.

Indro understands the importance of RPIC disclosing the information within the time allocated. Indro also understands that this reporting activity is mandatory for remote pilots in command operating under 14 CFR Part 107. A certified remote pilot in command's failure to report an accident may result in enforcement action and civil penalties pursuant 14 CFR Part 13.

### 11.4.6 NOTAMs

NOTAMS will be posted as required for the planned area of operations. Additionally, aircraft will support and use the Flight Service Station processes provided by: https://www.1800wxbrief.com/Website/#!/. No less than 24 hours before conducting operations that are the subject of this Waiver, a Notice to Airmen (NOTAM) must be filed. The NOTAM must include location, altitude, and operating area, time and nature of the activity;

## 12 Lost Link Procedures or Loss of Positive Control

- When the C2 link is lost, a specific set of deterministic actions. A detailed description is provided in Indro SOP section 3.3.

## 13 Communication Expectations w/ATC

- All engagements with ATC will be preplanned with the local/regional ATC before the flight.
- Furthermore, local/regional ATC expectations for communications during the actual flight will be planned before the flight.
- As noted, a primary and backup communication process is developed with the local and regional ATC before flight operations.